

ADULT STEM CELLS CANNOT SUBSTITUTE FOR EMBRYONIC STEM CELLS

Some people mistakenly believe that adult stem cells offer the same, or better, potential as embryonic stem cells for treating disease. This reflects an incomplete understanding of the qualities of the respective stem cell types. While embryonic stem cells have qualities that give them the potential to treat a wide range of diseases and injuries, adult stem cells simply do not.

Adult stem cells exist in small amounts in several tissues in the body, helping maintain and repair those tissues. They typically have the capacity to become any cell type in that particular tissue. Scientists have been studying adult stem cells for about 35 years, and federal funding for adult stem cells is 10 times that for embryonic stem cells. Most people are familiar with the blood-forming hematopoietic stem cells, which have proved useful as replacements for selected components of the bone marrow. However, adult stem cells have limited potential for treating most diseases for a number of reasons.

LIMITATIONS OF ADULT STEM CELLS

- **ADULT STEM CELLS CANNOT BE INDUCED TO DEVELOP INTO ANY CELL TYPE.** The hope has been that adult stem cells can be coaxed into developing into other cell types, i.e., blood cells turning into nerve or muscle cells that then could be transplanted into patients with disease. Some experiments have suggested that adult stem cells might have the ability to convert like this. However, more recent studies have cast serious doubt on the ability of adult stem cells to transform. The studies have provided alternate explanations—for example, adult stem cells that appeared to change type had actually fused with other cells.
- **ADULT STEM CELLS ARE DIFFICULT TO IDENTIFY, ISOLATE, PURIFY, AND GROW.** The cells exist in such small amounts that they are hard to locate for study. For example, scientists knew for decades that there must be adult stem cells in the skin, but they were isolated and identified only within the last few years. In addition, adult stem cells are much harder than embryonic stem cells to grow in culture. It is a biological truism that after cells leave their primitive state and begun to specialize, they lose much of their capacity to multiply. Because of the cells' limited number, researchers question whether adult stem cells could be grown in quantities that are clinically significant for many diseases.
- **ADULT STEM CELLS MAY NOT EXIST FOR SOME TISSUES, INCLUDING INSULIN-PRODUCING CELLS.** In May 2004, Harvard University researchers found that in mice, new insulin-producing cells in the pancreas are formed through the replication of existing beta cells rather than through the differentiation of adult stem cells.¹ This finding has important implications if confirmed in humans.

In order to cure type 1 diabetes, scientists may have to rely on an external source of insulin-producing cells because the adult stem cells in the pancreas do not appear to contribute to insulin-producing cell formation. This same situation may exist for other tissues and the diseases that affect them.

CELL-REPLACEMENT THERAPIES SUCH AS ISLET TRANSPLANTATION REQUIRE AN UNLIMITED SOURCE OF DONOR CELLS TO HAVE WIDESPREAD SUCCESS—WHICH ADULT STEM CELLS CANNOT PROVIDE. Islet transplantation (and similar procedures like organ transplants) are severely limited by the availability of donor tissue and organs. Human embryonic stem cells, discovered only recently (in 1998), have far greater potential for providing replacement cells in sufficient numbers to be therapeutically useful.

EMBRYONIC STEM CELLS DO NOT HAVE THESE LIMITATIONS

- **EMBRYONIC STEM CELLS HAVE POTENTIAL TO DEVELOP INTO ANY CELL TYPE—BRAIN CELL, HEART CELL, INSULIN-PRODUCING BETA CELL OR NERVE CELL.** This means that embryonic stem cells could produce replacement cells for any tissue and have an impact on virtually every disease.
- **EMBRYONIC STEM CELLS ARE CAPABLE OF DIVIDING AND RENEWING THEMSELVES FOR LONG PERIODS.** This means that they offer a potentially unlimited source of cells for organ transplantation and other cell-replacement therapies.
- **EMBRYONIC STEM CELLS CAN EASILY BE GROWN IN CULTURE, AND SCIENTISTS ARE IMPROVING THE METHODS BY WHICH THIS IS DONE.** The cells lend themselves readily to investigation and distribution—provided scientists have the funding to study them.
- **EMBRYONIC STEM CELLS OFFER UNIQUE INSIGHTS INTO HUMAN DEVELOPMENT AND A WINDOW INTO THE BIOLOGY OF DISEASE.** Embryonic stem cells represent the earliest stages of cellular development, allowing scientists to see when things first begin to go wrong to lead to disease. Adult stem cells do not have this quality.

¹ *Adult pancreatic beta cells are formed by self-duplication rather than stem-cell differentiation* Dor Y, Brown J, Martinez OI, Melton DA. *Nature*. 2004 May 6;429(6987):41-6.